CHAPTER 7.0

Conclusion & Recommendation

Objective 1: Evaluate the effectiveness of the window design of British Colonial Residences for improved indoor thermal, daylighting and ventilation condition in the urban climate of Kuala Lumpur

Method used to evaluate the performance of window design of British Colonial Residence for this study was Window to Wall Ratio (WWR), field measurement of indoor and outdoor condition of the selected residence and computer simulation test.

The selected five British Colonial residences' windows in Kuala Lumpur were calculated for window to wall ratio. From the result of window to wall ratio, only one building from these five buildings had been selected for case study. Field measurement on indoor thermal comfort and micro climate factors and simulation test had been carried out on this specific building as to search for an ideal window design which is suitable to apply for modern building.

Window to wall ratio for the five selected British Colonial Residences showed that there are windows allowed optimum ventilation, windows allowed insufficient air exchange or windows that caused overheat to the rooms. Windows that allowed optimum ventilation and daylight into the rooms is stated as below and result showed that majority windows in case studies are not efficient.

a. JKR 511 –7 no of windows from total of 60 nos
b. JKR 989 –1 no of windows from total of 54 nos
c. JKR 1331 – 0 nos of windows from total of 49 nos
d. JKR 1716 – 2 nos of windows from total of 62 nos
e. JKR 541 – 8 nos of windows from total of 25 nos

Field measurement has been carried out to test the performance of windows and the effects of micro climate on the thermal comfort of the occupants. JKR 989 had been selected to conduct field measurement. Reason for selecting JKR 989 had been explained in Chapter 5. JKR 989 had been divided into four zones. Four zones located at different orientation, for example zone 1 located at North East, zone 2 at North West, zone 3 at South West and zone 4 at North East. Results showed that Zone 1 which is the hottest zone does not have the lowest amount of humidity. This is because of the water feature introduced in front of a neighbouring building (Royal Chulan Hotel). From the field measurement result, only window in Zone 2, W2, manage to cool down the room when the windows are opened.

AIOLOS was used to test the windows' performance for all window designs in JKR 989 and the results showed that all the window designs in case study do not meet the air flow rate set by ASHRAE which is 34m^3/hr. Window design which has the highest air flow rates compared to other window design in JKR 989 is W2. AIOLOS showed that large windows able to cool down the internal temperature of a room better than smaller windows.

AIOLOS calculated on ideal width for all the windows in JKR 989 when the height of the windows are fixed to 2.5m which is common for British Colonial style buildings. This ideal width will allow optimum ventilation into the room. The result clearly showed that almost all the windows in JKR 989 need to improve its width in order to have more ventilation into the room. Only the width for one of the window need to be reduced to have better ventilation. The existing W2 window, has the least width difference compared to the ideal width calculated by AIOLOS.

Daylighting is insufficient in four zones in JKR 989 which is less than 300lux. Although zone 2(meeting room) has high ceiling and clerestory windows, they contributed less in daylighting. This is because clerestory windows that located in zone 2 are timber louvered windows which only contribute to better air circulation.

Objective 2: Evaluate the impact of urban microclimate on the indoor thermal comfort and daylight performance of British Colonial Residences in Kuala Lumpur.

Field measurement and simulation test confirmed that microclimate plays an important role on the thermal comfort of occupants in JKR 989. All the concrete and bricks buildings contributed to heat island effects and obstructed wind flow when the surrounding of the building is developed. Window performance of JKR 989 had been affected by this change of microclimate and result of PMV and PPD showed that temperature in selected zone was unacceptable. Comparison of indoor and outdoor temperature JKR 989 is shown in Table 7.0 of field measurement conducted on July 2010:-

Table 7.0: Comparison of indoor and outdoor temperature and relative humidity JKR 989

	Indoor Average Mean air Temperature (ºC)	Average Mean Relative humidity (%)	Remarks
Indoor	30	72.5	Air Temperature indoor is lower than outdoor
Outdoor	32.4	75.3	Relative humidity indoor is lower than outdoor

The average mean indoor air temperature JKR 989 is lower than the average mean external air temperature. However, it is noted that the indoor average mean relative humidity for JKR 989 is lower than the average mean external humidity. This is because existing surrounding building located in front of JKR 989 such as the Royal Chulan Hotel assisted in lowering the microclimate by having a large water feature in front. This water feature can lower down internal air temperature of JKR 989 especially during noon.

The Bioclimatic chart also shows that the indoor thermal comfort for zone 2 is unacceptable. Adjustments need to be done to reduce the internal air temperature and relative humidity. From the bioclimatic chart, the upper limit of comfort temperature set by Malaysian standard is 30.7ºC, relative humidity is 65%. As to decrease internal temperature and relative humidity, more windows need to be introduced as to encourage air exchange and air flow rate. Referring to bioclimatic chart derived from Western countries; they are not suitable for tropical countries. This bioclimatic chart needs to be validated for the tropical climate.

This study shows that British Colonial residences in urban set-up is suggested to be retained although this type of house has lost its characteristic as climatic responsive buildings. However, the indoor condition of British Colonial Residence can be improved

by introducing more openings to this type of houses as to cool down the internal temperature and encourage better air circulation in the building. Some recommendations to improve the daylight in JKR 989 are to change the timber louver windows into glass louver windows. Additional light shelves can be incorporated into the room in order to have better lighting.

As scope of this study was limited to five houses representing bungalows in Malaysia, it is therefore recommended that a deeper understanding could be achieved by extending this study to more samples of houses of different types and a longitudinal study of the indoor thermal comfort. It is also recommended to include the impact of heat island effect on indoor thermal sensation in future studies.